ENTERPRISE

GAS APPARATUS,

FOR

Illuminating and Heating Purposes.

JAMES BUJAC,
PATENTEE.

ADDRESS ALL COMMUNICATIONS TO

WM. F. BOOGHER, Business Manager,

1331 F Street, Washington, D. C.

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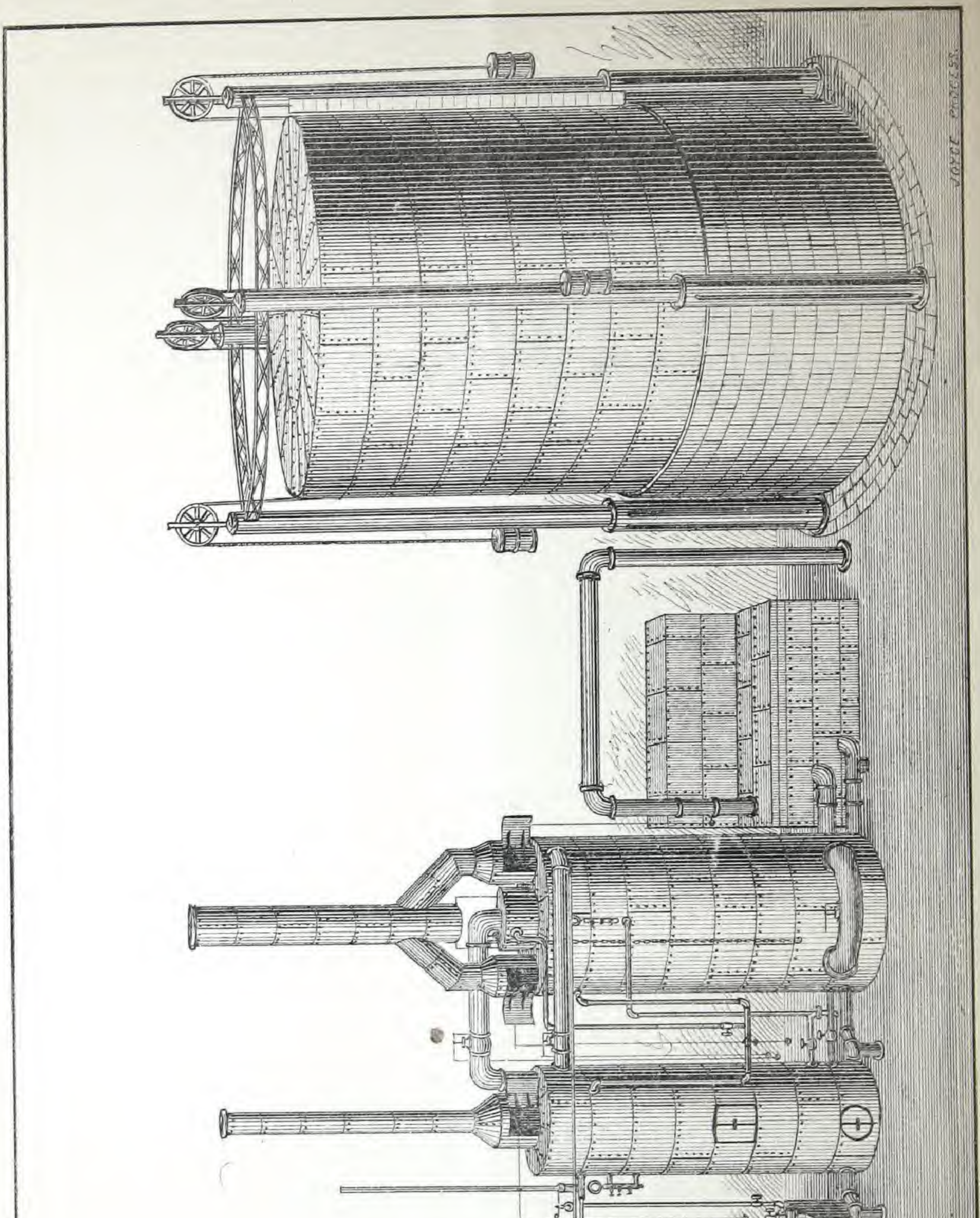
JOYCE PROCESS.

ENTERPRISE GAS APPARATUS.

The purpose of this pamphlet is to demonstrate the advantages of the "Enterprise Gas Apparatus" for producing *permanent combustible* gases by the contact of vapor of water with incandescent fuel. Whilst doing this we wish to be fully understood that no claim is made to the discovery of the reactions which take place in this operation. Being conversant with the results obtained by Lavoisier, Cavendish, Priestly, Watt, and the eminent physicist, Gore, in this direction, in the latter part of the last and the beginning of the present century, and the application of their discoveries, both in Europe and America, to the production of gas for illuminating and fuel purposes, therefore it is here only necessary to demonstrate by comparison of cost and quality of product to show the advantages of this apparatus. The principal factors in the cost of production are labor, fuel, and naphtha. To utilize these factors for the purpose indicated the construction of an apparatus which would yield the largest product from a given amount of material employed proved indispensable. This we propose now to show has been attained in the "Enterprise Gas Apparatus."

The labor of the laboratory having definitely shown the amount of available heat, which a given quantity of a known fuel will yield when burned, renders it apparent to those who have given attention to the enormous amount employed for domestic and industrial pursuits, that the present system of consuming fuel falls far short of that standard of intelligence made manifest in this century by the improvements which have been attained in every branch of the industrial arts, save this, as the results obtained by the present system prove that the ingenuity of man has failed to extend the zone of complete combustion beyond what, in our present state of knowledge, seems to be its well defined and pre-

scribed limits; or in other words, he has failed to supply a fire or burning heap of fuel with sufficient atmospheric oxygen to effect its immediate conversion into carbonic acid and vapor of water.

One pound of coal when completely burned will yield 13,000 units of heat; hence one ton of 2,240 pounds will yield 29,120,000 units, which at the prevailing figures costs $6.50. Yet by the existing methods of consuming fuel in stoves, grates, ranges, and the like, of the very best construction, ten tons of coal are consumed, capable of yielding 291,200,000 units, which cost $65.00 to obtain 29,120,000 units, worth $6.50, whilst there passes out of the chimney nine tons of unburned fuel, capable of yielding 262,080,000 units, costing the consumer $49.50; therefore in our present manner of consuming fuel in our houses we pay $65.00 for the amount of heat which should be obtained from one ton of coal. Although the amount of heat utilized for industrial purposes far exceeds that obtained for domestic use, yet with the exception of the blast furnace, in which is obtained from 30 to 34 per cent. of the available heat; while for generating steam and other purposes, it is rare that more than 15 or 20 per cent. is obtained. Assuming that the quantity of coal consumed for all purposes in the United States is as great now as it was in the year 1876, which was then 41,000,000 tons, the average cost of which was $4.00 per ton, or $164,000,000 for the whole, and that three-fifths, or 24,600,000, tons are consumed for domestic purposes, of which 10 per cent., or 2,460,000 tons, costing $9,840,000, are actually utilized, and that the other two-fifths, or 16,400,000 tons, which are employed in the industrial arts, of which an average of 40 per cent., or 9,840,000, are utilized, therefore of the 41,000,000 tons, there is actually burned only 12,300,000 tons for all purposes, the value of which at $4.00 per ton is $49,200,000, whilst the consumer, paying as he does for the whole 41,000,000 tons $164,000,000, actually pays for domestic purposes $40 per ton for his fuel, while in the industrial arts coal costs the manufacturer $16.67 per ton. Thus this want of a proper system of burning fuel imposes a tax of 1,000 per cent. on the citizen for cooking his food

and warming his house and of more than 400 per cent. on all manufactured articles which he uses.

The inherent difficulties of burning crude fuel, which cause the immense losses, which have just been shown, are consequent upon the unavoidable necessity that the fuel must be gasified and brought in contact with atmospheric oxygen before it can be burned, thus necessitating the introduction into the fire of a large amount of atmospheric air, whose incombustible residual nitrogen necessarily absorbs and carries off a large portion of the heat generated, to which may be added the amount absorbed by the furnace and those *inevitable reactions*, the decomposition of water into its elementary constituents and the inverse combustion of carbon, by which the carbonic acid is converted into carbonic oxide, which must and do take place in every fire or burning heap of crude fuel.

Owing to the manner in which crude fuel is consumed, the only portion which is actually burned is that resting on the grate bars and a short distance above; beyond this, there is no atmospheric oxygen, and the fuel is merely dissipated without being burned. Ladened with absorbed heat, this unburned fuel passes out of the stack, and coming in contact with atmospheric oxygen, is burned, which produces the flame seen issuing from the stacks of furnaces.

Experiment has proved that 1 lb. of anthracite coal will produce, by its complete combustion, 13,000 units of heat, a calorific effect sufficient to convert 13 lbs. of water into steam at 212° F. As 1 lb. of water contains 31.12 cubic inches, 13 lbs. of water are 0.23 of a cubic foot; and as one volume of water produces 1,696 volumes of steam, 0.23 of a cubic foot, or 13 lbs., will produce 397.06 cubic feet of steam; hence a ton of coal of 2,240 lbs. will yield, when completely burned, 29,120,000 units of heat, a quantity sufficient to evaporate 29,120 lbs. or 3,640 gallons of water, which will produce 889,414 cubic feet of steam.

The results obtained with the very best steam-boilers of to-day show very different results from those just stated, and prove that the most perfect of these apparatuses do not

utilize more than 25 to 30 of the available heat of the fuel which they consume; consequently they produce but one-third of the quantity of steam, or 296,471,33⅔ cubic feet, for a ton of coal, one-third the quantity which the fuel consumed is capable of generating when completely burned.

PETROLEUM.

The carbureter used in the "Enterprise" is that product obtainable from the distillation of crude petroleum, at a temperature of from 140° to 158° F., having a specific gravity of about 0.675, and containing chiefly a mixture C_5H_{12} and C_6H_{14}.

Liquid hydro-carbons require the most careful manipulation when converting them into gas, for if exposed to a temperature exceeding 960° F. their carbon is deposited and they loses their luminosity, and if the temperature is not sufficiently elevated then the greater portion is converted into heavy vapors, which, condensing, form the residual, coal-tar; hence the necessity of maintaining a uniform and uninterrupted temperature for this purpose, say not less than 850° F., by which means the carbureter is converted into permanent gases, without the *loss of carbon*, thereby reducing the amount of carbureter necessary to its minimum quantity. Thus with the quantity of proto-carbureted hydrogen formed during the disassociation of the vapor of water, with the addition of 1½ gallons of naphtha, we obtain a gas possessed of 22 to 24 candle power.

Your attention is called to the method of making gas with the "Enterprise Gas Apparatus." The fuel in the fire-box of the tubular boiler having been properly lighted, and the valves and closings adjusted, the blast is applied. The product arising from the fuel thus consumed is conveyed into and through the flue of the second boiler. From thence it passes through the branch pipes into the flues of the brick jacket, where it is met and supplied with atmospheric air from the blast pipes and burned. The products of this final combustion then pass into a compartment containing a stack of convoluted pipes, through which the air supplying the

blasts is made to pass. In this manner, with the one fire, the water in both the tubular and flue boilers is vaporized and the flues in the brick jacket are properly heated, one of which attains a temperature of from 1,800 to 2,000° F., and the other from 600 to 800° F. The air blasts are now discontinued, and the steam from both boilers is conveyed into the highly-heated flue, where it is fully elaborated.

The steam thus fully elaborated, highly heated, and dried is made to pass in immediate contact with the incandescent fuel in the fire-box of the tubular boiler, by which it is resolved into the elementary gases, hydrogen and oxygen. The oxygen combining with the carbon of the fuel is converted into carbonic oxide, and a portion of the hydrogen into the carburet CH_4, the balance remaining free. These gases now pass into the flue, the temperature of which is from 600 to 800° F. There they meet and are thoroughly mixed with the carbureter obtained by gasifying naphtha. The gas then passes into the hydraulic main lime-box, &c., into the holder.

Allow us here to recall to the mind of the reader the reactions which take place in a heap of burning fuel. When fuel is consumed in the ordinary manner under steam-boilers, &c., that portion resting on the grate-bars and a short distance above it, only, is supplied with sufficient atmospheric oxygen to effect its combustion. In this zone of complete combustion two volumes of oxygen combine with one of carbon, producing the gas, carbonic acid, and the hydrogen produces the vapor of H_2O. Beyond this well-defined limit the superincumbent strata is deprived of oxygen sufficient for combustion, yet the fuel is rendered incandescent from contact of the highly-heated gases which pass through it. The carbonic acid produced in the zone of combustion in passing through the upper strata of fuel combines with another volume of carbon equal to that which it already contained, and is converted into two volumes of carbonic oxide, and the vapor of water is decomposed, forming carbureted and free hydrogen. Owing to this immense increase in the volume of gases, there is absorbed and rendered latent nearly all the heat which the fuel had evolved; for, in

the transformation of carbonic acid into carbonic oxide, the fuel yields only 0.234 of the total quantity of heat, which the same amount of carbon evolves when it is completely burned. These gases mingling with the residual nitrogen, pass out of the stack. These are the reasons "*why*" and the manner in which fuel is merely dissipated instead of burned.

Now, in the "Enterprise Apparatus," instead of allowing these products of reaction to escape from the stack of the tubular boiler, they are made to pass into the flues of the brick jacket, and are there burned as already described. In this combustion one pint of vapor of carbon combines with two pints of oxygen and evolves 3,929 units of heat, and forms one quart of carbonic acid. The quart of carbonic acid passes up through the fire and is converted into two quarts of carbonic oxide, which absorbs 2,331 units of the heat which the pint of carbon had evolved. Thus the tubular boiler receives only 0.234 of the quantity of heat generated. The two quarts of carbonic oxide thus produced pass into the flue of the second boiler, thence into the flues of the brick jacket, where it is completely burned and converted into two quarts of carbonic acid, and evolves 6,260 units of heat Thus, in these successive combustions, one quart of the vapor of carbon has yielded a sum total of heat disengaged equal to 3,929 + 6,260 = 10,189 units of heat. The same quart of vapor of carbon burning completely and immediately converted into carbonic acid would disengage 7,958 units of heat; consequently the conversion of one quart of carbonic acid into two quarts of carbonic oxide absorbs a quantity of heat represented by 10,189 — 7,958 = 2,331 units, which are again evolved, when the oxide of carbon is burned and converted into carbonic acid, as it is done in this apparatus.

Assuming that the tubular boiler receives 30 per cent. of the available heat of the fuel consumed in the fire-box, or 8,736,000 units of heat, whilst the amount of fuel thus saved and burned in the flues of the brick jacket evolves 20,384,000 units. In this manner the "Enterprise Gas Apparatus" saves 70 per cent., or seven tons out of every ten; or, in other words, this apparatus produces, by consuming

three tons of coal, as much and more gas as the best-constructed apparatus which consumes ten tons.

The construction of this apparatus is based upon the above facts. This method of producing gas employs but one fire in the furnace of the tubular boiler, and is sufficient for all purposes, as it performs the work effectually:

First. By the saving of fuel as just explained.

Second. The compact structure of the apparatus enables the complete utilization of the heat evolved.

Third. By vaporizing the carbureter, at a proper temperature, producing permanent gas, free from oily vapors, without the deposition of carbon.

Fourth. The steam is produced, under proper pressure, and consequently elevated temperature.

Fifth. The steam, on issuing from the boilers, is made to pass, in its transit to the furnace, through the highly-heated flue of the brick-jacket, by which it is completely elaborated, acquiring an elevated temperature, in which condition it is brought in contact with the fuel of the furnace.

Sixth. Steam thus prepared before entering the furnace enables a large saving of fuel by permitting a greater volume to be passed through the incandescent fuel in a given time, obviating the necessity of frequent interruption of gas-making to blow up the fire at short intervals.

Seventh. The highly-heated products of combustion are made to pass into the compartment containing the stack of convoluted pipe, through which the air supplied to the blast passes. In this manner the air supplied to the apparatus for combustion acquires a temperature of from 500° to 700° F.

Eighth. The juxtaposition of the several parts of this apparatus enables the maintenance uninterruptedly of a sufficiently increased temperature for producing the required results and utilizes all the heat evolved except that unavoidably lost from radiation.

An apparatus of the size shown in the diagram will produce, after heating up from 8,000 to 10,000 cubic feet per hour of illuminating gas of 22 to 24 candle power. In a continuous run of one day (ten hours) it will turn out from

110,000 to 120,000 cubic feet. The labor required is the engineer, his assistant, and a man-of-all-work The material required is 3,600 lbs. anthracite coal, 160 gallons of naphtha, coal costing $4.70, naphtha $6.40, labor $4.75, a sum total of $15.85 to produce 120,000 cubic feet of gas, which is now selling from $1.60 to $2.00 per 1,000 feet. The cost of constructing such an apparatus is from $10,000 to $12,000. An apparatus suited for factories, villages, &c., is so modified as to meet the requirements of each class of consumers.

No improvement introduced in the last half century has produced such wonderful results in the development of the arts and industrial pursuits as the application of gas for illuminating purposes, whilst important progress has been realized in its manufacture. More has been been done in perfecting the apparatus necessary for its production than the discovery and application of anything new. We have become so accustomed to this kind of light, that like most things familiar, we lose sight of its magnitude; yet on comparison of the present with the past we cannot but see the direct and indirect effect of gas-light upon the advancement of the age. It has been tersely said on this subject that its direct effects have been to convert night into day, to make the short and obscure days of the winter equal to those of the summer, give more time to those occupied with indoor pursuits, and enable them to conduct their labors with less fatigue to the eye and more certainty of execution. In this aspect only the immense wealth which has been added to the industrial arts is incalculable. In its indirect effects it has benefited society by saving vast tracts of land for other agricultural purposes that would have to be devoted to the culture of plants furnishing oil and fatty matters to be used for illumination, besides which there have been saved for other purposes hundreds of ships and thousands of seamen that would be requisite for the purpose of procuring oily matter to be used for furnishing light. Regarded as a luxury its benefits are not to be despised, inasmuch as it has cheapened many of them to such a degree that both rich and poor are equal participants in the glorious benefits derived therefrom.

Our brilliantly-lighted streets are evidence of this fact, enabling the multitude to traverse our cities with the same ease and security at night as well as in the day, a luxury appreciated by those who recall to mind the miserable oil-lamps of the past, whereby the streets and lanes of all great cities were formerly lighted. In fact gas, like other great discoveries, was a necessity for which the world was prepared and which it required. A cheap, brilliant illuminating gas means freedom from the horrors of coal-oil explosions, and consequent loss of life, conflagration and destruction of property; it admits of mental culture, pleasure, and health, with security to life and property.

In this connection it would have been superfluous to have entered into a detailed and labored review of the merits and demerits of the different systems which have been and are still employed for producing illuminating gas, as we have no connection or interest in what has, or is at present being done by others; for, if the explanation in this pamphlet is sufficiently clear to convey a distinct understanding of the construction of our apparatus and the chemical reactions which it enables, then we have accomplished the objects of the foregoing sheets by having placed before a discriminating public the means of comparison, a test which cannot fail to show the advantages of the "Enterprise Apparatus," and dispel such erroneous impressions as may have been received from misstatements of the envious, and those interested in the present system of gas and other modes of illuminating, or impressions received from those incapable of explaining the subject with which they claim to be conversant.

We yet have a few words to say in regard to the many advantages of the pipe-line gas system.

1st. The apparatus is erected at the place where the fuel is (at the mine), and can be moved from place to place instead of moving the immense bulk of fuel to the apparatus, so that the coal is fed to the apparatus right from the dump or cart, thus saving railroad freights and the several handlings in loading and unloading cars. hauling to yard, etc.

2d. The cost of a pipe line is insignificant when compared

with the cost of building, equipping, running and maintaining a railroad, and yet the simple pipe line does all the work required of it. It is free from collisions, explosions and the consequent loss of life. It interferes with no person's property, it causes no conflagrations by which houses, barns, fences and forests are destroyed, consequently it has no suits for damages. In fact it is the surest, most certain and cheapest means of transporting material for fuel and light.

3d. By making the gas at the mine the ash and other incombustible matter, slate, etc., which amounts to at least 20 per cent., is left at the place of production. This saving adds to the margin of profit to the pipe line, as the gas companies who manufacture in the cities have to pay for transporting this useless material (ash and slate).

4th. The gas is produced from that form of fuel or carbon which at the place of production has but little if any market value; in fact it invariably represents the minimum figure in the cost of fuel.

5th. A city, town or village supplied by pipe line requires but the gasometers to store a supply sufficient for the station. Thus one apparatus or gas works may supply many stations, etc.

6th. The gas for illuminating can be carbureted at the point of distribution, thus obviating all danger of loss of carbon in long transits.

7th. The consumer is served with fuel and light in every room in his house without needing a servant and without danger of fires and coal oil. Free from the loss of 20 per cent. of ash and slate, it is controlled by a valve, lighted with a match, and radiates heat at once. It can be regulated so as to give more or less heat, and concentrated at the exact spot that the heat is needed, and yields from five to ten times as much heat as any other fuel, and it can be delivered to the consumer at a merely nominal cost.

Thus when we consider the inexpensive and simple apparatus required, the cheap fuel employed, the saving in cost of transporting and delivering fuel free from incombustible residual, a fuel whose calorific effect is from five to ten times as

great as any other, and its freedom from danger to life and property—when all these things are considered, every one can plainly see why we say that it defies competition from any fuel or light now known.

SUMMARY.

Although in the preceding pages, mention has been made of the loss incurred by the use of crude fuel, caused by the inevitable consequences which are inseparable from our manner in consuming it, we feel, owing to the importance of the subject, justified in calling both the attention and serious consideration again to this matter as a sanitary and economic measure or commercial enterprise. Although industrial chemistry has long since definitely pointed out the requisites necessary for combustion, yet the daily use of fuel shows how its teachings have been disregarded, as there still remains those inseparable difficulties of our present system which exist, unabated, in spite of the application of the almost innumerable devices of blasts, drafts, dampers, and towering smoke-stacks. That this should be so is more astonishing when we consider the intimate connection of heat with those domestic comforts and industrial pursuits which are the foundation of our national existence. For to this immense loss of material must be added the valuable factors of the time and labor expended in mining, handling, and transporting to our homes and factories a *crude fuel, unfit* for the purposes intended, and yet we submit to all these disadvantages, and the immense tax which is thus self-imposed, while the means of preventing them are at our command, by substituting a gaseous fuel for the crude, its advantages being fully demonstrated by the application of the present costly illuminating gas for fuel purposes, as well as the more extensive utilization of natural gases, for both domestic and industrial purposes, both in Europe and America.

In the conversion of solids or liquids into gases, there is necessary an expenditure of thermal force, which leads many to erroneous conclusions in comparing the calorific effects of different forms of fuel; whilst one pound of coal will yield

13,000 units of heat by its complete combustion, and one pound of this gas will yield 9,000 units; yet, when we recall to mind, that for domestic purposes we utilize not more than 10 per cent. or 1,300 units out of the 13,000 which the pound of crude fuel is capable of evolving, whilst of the gaseous fuel we obtain 90 per cent., or 8,100 of the 9,000 units which it will yield. Thus we have a saving of 6,700 units of heat in favor of this gas, or one pound of this gas will produce a calorific effect equal to 5.6 pounds of coal.

The advantages of a fuel gas are too numerous and well understood to admit of a lengthy description here. Suffice it to say:

1st. It is free from slate and other foreign matter.

2d. It is always in condition to be readily and completely burned, giving an immediate and uniform result.

3d. The flame can be concentrated at the exact place or point needed, giving a steady and constant heat, which is controlled by a valve, and can be graduated without loss of material.

In fact to sum up its innumerable advantages, gas as fuel defies competition of wood, coal, coke and petroleum, as it admits of complete combustion, utilizing 90 per cent. of its available heat.

The manner in which fuel-gas will be manufactured and delivered to consumers by those concerned in the "Enterprise Gas Apparatus" has never before been undertaken, as by an alteration of its ordinary grate the apparatus is made to utilize the coal-slack which is to be found in abundance near every coal mine and which is procured at a minimum cost. The apparatus being erected at the mine the gas will be transmitted by pipe-line, thus saving the heavy cost of transportation, which will enable the production and delivery of fuel-gas at a minimum price.

Commendation of the "Enterprise Gas Apparatus" is unnecessary. It speaks for itself. Its adoption and use brings joy, happiness, light, and warmth to all, whether rich or poor, and is the greatest economic innovator of the age.

CONDENSED SUMMARY

OF

THE ENTERPRISE GAS APPARATUS.

The means which are at present employed for effecting the disassociation of the elementary constituents of water and the properties of the resulting gases were discovered in the latter part of the past and beginning of the present century, since when nothing new has been accomplished in that direction except the introduction of apparatus intended to produce water-gas in large quantities for economic purposes.

The history of its application for illuminating, both in Europe and America, dates from the beginning of the present century, whilst the attempts made to produce it sufficiently cheap to be used as fuel are of a later date.

The essentials requisite of a prime illuminating gas are combustibility and a highly luminous flame, and for fuel it must be combustible and capable of producing a high calorific effect; to meet those requirements the gas must be free from admixture of condensable vapor and incombustible gas when used as fuel, to which must be added sufficient carbon to give it luminosity when intended for illuminating.

When water is decomposed by its contact with carbon the resulting product consists essentially of hydrogen and carbonic oxide, and a small quantity of light carbureted hydrogen, with which is mixed an insignificant quantity of nitrogen, carbonic acid and oxygen.

The necessary substances for producing fuel-gas by this process is coal and water, to which must be added the naphtha when the gas is intended for illuminating.

The cost of an apparatus such as is shown in our pamphlet

is ten thousand dollars all told. This apparatus in a continuous run of ten hours will produce 120,000 cubic feet of gas.

The cost of 120,000 cubic feet of gas from twenty to twenty-four candle power is :

Engineer per day	$2 00
Man to tend apparatus	1 50
Man of all-work	1 25
3,600 pounds coal, at $3.75 per ton	4 70
160 gallons of light naphtha	6 40
	$15 85

The above apparatus on a continuous run of twenty-four hours will produce 300,000 cubic feet of gas at a cost not exceeding $30, as only double the help will be required.

As water-gas is a product resulting entirely from chemical action it is evident that its production depends entirely on instituting and maintaining uninterruptedly those conditions which enable the reactions requisite for its production.

Thus the carbon must be incandescent, the vapor of water fully elaborated, and the naphtha converted into gas without loss of carbon from deposition, and to insure economy in its preparation the air supplied for combustion must be heated.

These conditions are not only of prime necessity but actually the requisite necessary, and without which water-gas cannot be produced. Why?

1st. If the carbon is not incandescent the vapor of water is not decomposed into its elementary constituents, and steam instead of gas is obtained.

2d. If the steam is not fully elaborated it will, by its contact, extract a large portion of heat from the fuel, and the carbon loses its incandescence, and the steam passes through it without being decomposed, thus necessitating frequent interruptions of gas-making to blow the fuel up to the proper temperature. Again, if the steam has a long distance to pass in its transit to the furnace it loses heat by condensation.

3d. When the naphtha is merely vaporized at an insufficient temperature it condenses and separates from the gas; if it is

gasified at too elevated a temperature it deposits its carbon; hence, in either of these cases it would require five or six times as much naphtha as is really required to give the gas sufficient candle power.

4th. When cold air is employed to effect combustion a large proportion of heat is abstracted from the furance, as the air must attain a given temperature before combution can take place; consequently this temperature which the air is made to acquire before entering the furnace is that much fuel saved, and adds to the uniformity of the operation by maintaining a more equal temperature.

5th. In producing this gas the disassociation of the elementary constituents of the vapor of water is effected by the contact of the steam with the incandescent (fuel); *if this is not effected then it is not effected at all, for in no portion of this or any other apparatus employed for producing water-gas is there attained a sufficiently elevated temperature to effect the disassociation of the vapor of water by heat alone.*

Owing to the peculiar and proper construction of this apparatus we are enabled:

1st. To effect the complete combustion of the fuel consumed.

2d. To utilize the absorbed heat of the products of combustion.

3d. Owing to the compact structure of the apparatus only a small per cent. of heat is lost by radiation, thus maintaining the apparatus in its several compartments *uniformly at the temperature required for effectually producing the required conditions,* by which means only is it possible to maintain uninterruptedly the production of a permanent gas of high illuminating power and of uniform quality.

The advantages which this apparatus affords over all others, are:

1st. One fire only is needed.

2d. The fuel employed is completely burned, as has been shown. The heat evolved is utilized owing to the compact structure of the apparatus.

3d. The carbonizer is vaporized at a proper temperature to produce permanent gas and at the same time retains the carbon.

4th. The steam is produced under a high pressure and consequent elevated temperature. It is then made to pass (in its transit to the furnace) through the flue heated from 1,800 to 2,000° F., by which means it is completely elaborated and acquires an accession of temperature.

5th. This dry steam (fully elaborated and possessed of a high temperature) admits of the passage of a large quantity of it through the furnace before it deprives the fire of the necessary degree of incandescence required to effect the dissolution of the elementary gases, thus obviating the otherwise frequent interruptions in gas-making from the necessity of applying the blast to maintain the proper temperature.

6th. The compact structure of the apparatus admitting the means which are employed for generating, elaborating, and conveying steam in a highly-heated condition to the furnace, enables the production of a much larger quantity of permanent gas in a given time than any other system now employed.

7th. Hot air from 500 to 700 degrees is supplied by the blast.

8th. The advantages above enumerated enable the production of gas at the minimum cost. As we have already said, the apparatus could be adapted to suit all classes of consumers, and we will now add that the greater its capacity proportionally less is both the cost of apparatus and product; thus an apparatus with a capacity of 576,000 cubic feet in a run of twenty-four hours costs $15,000, anon a gas works with the capacity of 2,880,000 cubic feet per day would cost proportionally less than the small apparatus and would produce gas cheaper on a continuous run.

JAMES BUJAC,
W. F. BOOGHER.

Patent allowed April 16, 1885.